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PRACTICAL ELECTRICITY.

Practical Electricity: a Laboratory and Lecture Course for First Year Students of Electrical Engineering, based on the International Definitions of the Electrical Units. Completely rewritten by W. E. Ayrton, F.R.S. Vol. i. *Current, Pressure, Resistance, Energy, Power, and Cells.* Pp. xviii + 643, with 247 illustrations. (London: Cassell and Co., Ltd., 1896.)

THAT the progress of electricity during the last decade has been great appears in many ways; but none shows this progress more strikingly than a comparison of a new and up-to-date book on practical electricity with the work as it originally appeared ten years ago. Prof. Ayrton's book was well-known to all laboratory students of electricity; it contained in moderate compass a vast amount of detailed information of great value, and it had marched well with the times. But the decision of the author to recast his matter, and to issue the book in an entirely rewritten and rearranged form, was none the less a wise one. He has now freer scope to put things in their newer relations and lights, to introduce new matter, and to emphasise those points and topics which still further increased experience and the trend of applications show ought to be more insisted on, and ought to bulk more largely in a thoroughly modern treatment of the subject.

So far only one volume of the new book has been published, and that deals with current, pressure, resistance, energy, power, and cells. The treatment of these topics, it is needless to say, is fresh and vigorous throughout. The individuality of the author is evident in every page, and however we may differ in opinion from him on such subjects as order of discussion, choice of starting points, and the like, there can be no question that for every position taken up, and every deviation from the ordinary routine of an elementary treatise on electricity, the author is provided with a reason which commands attention and respect.

In the brief review which we here propose to make of this volume, we shall first note some points that have struck us in a general survey of its contents, and then allude more particularly to some matters of detail. First, there is the very large number of clearly drawn and well-chosen cuts with which its pages are illustrated. There are 247 in all, about one to every two pages and a half, and about three out of every four of them have been drawn for the present work. This feature of the book is refreshing as contrasted with what one finds in so many text-books, which seem to be to a large extent written up (?) to a somewhat well-worn set of "process" cuts.

Some of the pictures of instruments are beautiful examples of what such illustrations should be. If a shaded diagram is given, it should be clear, and not, as it often is, a more or less smudged kind of impressionist representation of the instrument. Then, essential parts hidden away behind coils or in tubes should in some way be disclosed, and not left to be imagined from a verbal description. Thus, in the drawings of current-meters, in various parts of the book, the device of showing the coils cut open to display the construction, and to reveal suspensions and suspended coils and needles, is adopted with great effect. Some of the cuts of lines of force, which have evidently been engraved from photographs of the actual arrangements, strike us as the finest we have seen; notably one (Fig. 34) of the lines of force in a plane through the axis produced by a circular coil carrying a current, and two (Figs. 57, 57 *a*) of the lines of force of a horse-shoe magnet with curved iron pole-pieces. These last are exceedingly instructive as regards concentration of field and remanent leakage of lines outside the space.

The printing and get-up of the book are all that can be desired. Printed on thin and at the same time opaque paper, it contains 600 pages of text within a bulk not larger than that often given to a book of little more than half the same amount of matter. A clear and well-arranged index has been provided by Miss Ayrton.

Now as to the particular points in the author's treatment, regarding which we would say a word. The book is professedly based on the international definitions of the various units. Hence the discussion of currents begins with the enumeration of the various physical actions of a current, and a decision is come to, the convenience of which is shown in various ways, to regard an unvarying current as proportional to the chemical decomposition it produces in a given time. The unit of current is *defined* as that which passed through a solution of nitrate of silver in water deposits silver at the rate of ·001118 of a gramme per second. Then is given in a very lucid manner much valuable information regarding electrolysis and the quantitative results that have been arrived at in the investigation of the electrolysis of silver and copper, and the electrolytic standardisation of current-measuring instruments.

Now, although the units referred to above have been the subject of international agreement, their adoption is a matter of practical and commercial convenience, and should not be allowed to supersede or put out of sight the direct derivation of the units of current E.M.F., &c., in the absolute C.G.S. system of units. An Order in Council is not a law of the Medes and Persians which cannot be changed; on the contrary, it will have to be altered in any respect in which, under the conditions of future practice, it is found to be too much at variance with later and more accurate determinations of electrical constants, in order to bring it into agreement with the absolute system. The derivation of the absolute unit of current from the magnetic action of a current has a great practical as well as theoretical importance, and constitutes, as it seems to us, the only proper *definition* of unit current. Of course, this definition necessitates, in the first place, a discussion of magnetic effects of currents; but this cannot be avoided, and is, of course, very adequately given later in Prof. Ayrton's treatise. But we prefer that it should come before the electrolytic discussion, as without a familiarity with the specification of the measure of a current by its magnetic action the full force of the results of electrolytic research cannot be quite appreciated. But this procedure adopted, the results of such research connecting currents measured by their magnetic action with their electrolytic effects comes in what seems to us both their natural and their historical place, and the choice of ·001118 gramme of

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silver, as the quantity deposited by the passage of the quantity of electricity which is to be taken as unity, loses the air of arbitrariness it must at first sight have to many readers of Prof. Ayrton's book.

The order more usually followed in this matter is also, quite as much as the other, in the spirit of the plan of giving in a treatise on electricity initial prominence to the electric current and its effects. We may remark, though not with reference to anything stated by Prof. Ayrton, that in a good deal of the talk about beginning at this point or that in an exposition of electrical matters, it seems to be forgotten that some previous discussion of elementary magnetic, or it may even be electric phenomena, is desirable and even necessary. To quite understand the action of a current on a magnet, it is necessary to know something about magnets and magnetic fields. The truth is that, in a system logically consistent, as the science of electricity to a very great extent is, the point of attack is very much a matter of convenience. It is possible, of course, and it is done in some recent discussions, to begin with Maxwell's or Hertz's equations for electromagnetic action, and work round to electrostatic action as a mere residual effect. Still, in all such exercitations, a great amount of previous knowledge is taken for granted. The teacher has a difficult task in any case, for he soon finds in whatever way the discussion is undertaken, that to know one thing with approximate completeness it is necessary to know everything else. The study is a process of gradual approximation to clear and accurate conceptions, and if this were more recognised, there would be less discouragement of some students, and on the part of others, less cocksureness and contempt of what does not excite their interest, or is only capable of discussion by methods which have the misfortune to meet with their disapprobation.

A very important section of the book before us is that which deals with the power developed in the circuit of a generator, the conditions for the evolution of the maximum power in the working part of the circuit, electrical and commercial efficiency, and the transmission of power. The thorough practical study of all these questions which Prof. Ayrton has made invests this part of the book with a special interest and authority. Nothing could be clearer and better illustrated by graphical exhibition of the results, and by practical examples, than this long chapter. Perhaps a somewhat more explicit warning might have been added with regard to the fallacy which people apparently *will* fall into of confusing the arrangement of maximum power with that of maximum efficiency. Of course the discussion of efficiency ought to be sufficient to guard against error; but we have not seen the last yet of what at one time seemed inveterate, the continual misapplication of the so-called law of Jacobi.

Of the chapter on cells, &c., we will only say that it is in moderate compass a veritable store of information, which would only be found with difficulty, if at all, after much searching of other books, and to ordinary students more or less inaccessible papers.

By completing the book Prof. Ayrton will confer a further great benefit on all students of electricity, technical or otherwise; and we hope the second volume will not be long delayed. A. Gray.

PRIMITIVE FRENCHMEN.

Formation de la Nation Francaise. By Gabriel de Mortillet. With 153 engravings and maps in the text. (Paris: F. Alcan, 1897.)

THE account which Prof. de Mortillet gives of the formation of the French nation is based upon archæological data. It is true that he depends on anthropological materials, but these are prehistoric, and therefore archæological. The anthropological investigations on modern Frenchmen by Broca, Topinard, and others have been neglected; even the brilliant researches of Collignon are not referred to. The book thereby loses somewhat in breadth, and the linkage of the past with the present, which the author so firmly appreciates, would have been brought home more forcibly to the general reader if these investigations had been summarised.

The author first shows that the Bible, legends, ancient texts, and even linguistics, are too untrustworthy to determine the origin of any people; reliance must then be placed on anthropology and palethnology, including archæology. The three terms, race, language, and nationality, are discussed clearly and tersely. Race is an anthropological fact and implies common descent, the prolonged action of environment or complete fusion of various primitive elements. Numerous examples, illustrated by maps, are given to show that the distribution of race and language are by no means identical. If Germany claims Alsace because the population speaks German, why does she retain French-speaking Lorraine? Nationality is a sentiment, and is not based on racial but on sociological reasons. The first half of the book deals with historical documents. The ethnic and geographical discrepancies of various classical authors are pointed out; few had any personal acquaintance with the people and places they described, and most of them romanced. Practically all agree in describing the Celts or Gauls and the Germans in the same terms. Tall, fair people, with blue eyes, white skin, very warlike, and readily undertaking great invasions and vast migrations, constructing neither temples nor towns, fighting naked, but very proud of their hair. But below this military aristocracy there were the common people, ignored by the writers, who constituted the patient and laborious democracy fixed to the soil, the true natives of the country, whom anthropology and palethnology have revealed. The Gallo-Germanic race is spread over nearly the whole of Europe, and extends into Africa and Asia, each band transporting its particular name to the different countries that it occupied.

The languages of France are next dealt with. The remarkable agglutinative Basque language is briefly dismissed, as are also the "Celtic" dialects. "The language spoken in Gaul before the Roman conquest is unknown by us." Various early inscriptions and prehistoric carved stones are briefly reviewed; the latter are classified under (1) simple decorative motives; (2) conventional and commemorative carvings; (3) symbolic carvings, very difficult to understand, but apparently not alphabetical. No reference is made to the remarkable painted stones from Mas-d'Azil.

The third section of the book is devoted to palethnology. Tertiary man is discussed. Mortillet admits

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